

## Knowledge and perceptions about indoor residual spray for malaria prevention in Mumberes division, Nandi County in Central province of Kenya

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### Abstract

**Background:** Malaria control and intervention tool usage and coverage in community depend on community acceptability and compliance. Indoor residual spray (IRS) and long lasting insecticide treated nets (LLINs) are the preferred and recommended intervention tools. This cross-sectional study was carried out to determine the knowledge and perceptions about indoor residual spraying for malaria prevention in Mumberes Division, Nandi County in Central Kenya.

**Methods:** Household heads were interviewed on the socio-demographic characteristics, knowledge about IRS, role played by IRS in control of malaria, role of household heads in IRS programme and frequency of spraying. The study used scheduled questionnaires to obtain the information from household members.

**Results:** A total of 348 household members were involved in the study. This study indicated that age, marital status, occupation and income levels were the significant ( $p < 0.05$ ) determinants of utilization of IRS among the rural communities in Mumberes.

**Conclusion:** This study has demonstrated that, malaria control through the use of IRS in the rural community can be conducted with full participation of the local community members.

**Keywords:** indoor residual spray, mosquitoes, malaria, transmission, knowledge, attitude, Kenya

### Introduction

Malaria remains a major public health problem mainly in the tropics and sub Saharan Africa. The current malaria control tools are indoor residual spraying (IRS) and long lasting insecticides treated mosquito nets (LLINs) (Salam *et al.*, 2014). Over time, there have been several global initiatives to control malaria. The roll back malaria (RBM) and the Abuja declaration are some of the recent attempts to co-ordinate efforts and provide more resources to reduce the burden of malaria in the world (Rugemalila *et al.*, 2006, 2007; WHO 2014). Global malaria control strategy stresses the selective use of preventive measures, in targeting the use of different vector control methods alone or in combination to reduce human vector contact (WHO, 2001). In Kenya, the government is committed to the prevention of malaria infection through various interventions outlined in the National Malaria Strategy (NMS) which includes, LLINs, IRS, larvae source reduction and environmental management. However, several intervention measures have failed to achieve some of the set targets in Kenya (Ministry of Health, 2001).

Since malaria vaccine development is slow and parasites resistance to antimalarial drugs is developing rapidly, vector control remains the most practical method for reducing malaria transmission in developing countries (Killeen *et al.*, 2004; Lucchi *et al.*, 2015a,b; Trape *et al.*, 2002). The World Health Organization has widely promoted the use of LLINs as a means of reducing human–vector contact and consequently controlling malaria transmission (WHO, 2003). However LLINs may also face setbacks such as nets not being fitted well, getting torn because of excessive use, thus giving mosquito's easy access to a blood host (Phillips-Howard *et al.*, 2003; Rehman *et al.*, 2011; Irish, 2014).

Previous studies showed that community understanding of and beliefs about the purpose of an IRS programme varied but with less importance being attached to malaria transmission prevention (Munguambe *et al.* 2011; Ediau *et al.*, 2013; Gobena *et al.*, 2013). Other studies have

found that, members of community and head of households have positive expectations when IRS and LLINs or related interventions are installed in the community (Ediau *et al.*, 2013; Singh *et al.*, 2014). However, in other parts community have concerns on the negative impact and fears on IRS programmes, which may lead to refusal of the intervention (Ediau *et al.*, 2013). Therefore, addressing community concerns about IRS and LLIN coverage and ensuring that misperceptions are corrected ensures responsiveness to community needs and increases uptake of interventions (Atkinson *et al.*, 2010; Ediau *et al.*, 2013; Kassam *et al.*, 2015). However for malaria control strategies using IRS to be more effective, meaningful and sustainable, aspects such as community knowledge, attitudes and practices has to be taken into consideration (Okumu *et al.*, 2011). Thus this study investigated community knowledge, attitudes and practices on indoor residual spraying as a control tool for malaria transmission in Mumberes Division, Koibatek District in Kenya.

## **Materials and Methods**

### **Study area**

This study was conducted in Mumberes division, Koibatek district in central Kenya. The division (0°10' N, and 35° 15'E) located at an altitude of 2,700m above sea level, covers an area of 108 km<sup>2</sup>, with two locations, 4 sub-locations and 14 villages (Statistics, 2004). This study site has one health centre, one dispensary and two private clinics. The area receives an average rainfall of 1,200 mm per year with long rains starting at the end of March and end in July. The peak of the rainy season is in May. The short rains start at the end of September and ends in November with the maximum rains in October. A dry season experienced in January.

### **Study design and sampling procedure**

This was a descriptive cross-sectional study. Cluster sampling technique was used for selection of groups of the study unit's (clusters). A list of all clusters i.e. the 14 villages in the study area were constructed and formed the sampling frame. The district and division were purposively selected and applying area sampling technique, the clusters were listed and the percentage number of household in each cluster determined. Using probability proportional to size method the required sample size was proportionally drawn from all the clusters. Then selection of household within the sub-location was done using the standard cluster methods.

### **Data collection procedure**

The interviewer schedule questionnaire was divided into four parts; part one collected data on the economic status and socio-demographic information; part two consisted of questions relating to community knowledge on malaria using IRS as a control tool; while part three related to community attitudes on malaria using IRS as a control tool; and part four collected data on community practices on malaria using IRS as a control.

Data collectors were recruited from the study area and trained to administer the questionnaires. Completed questionnaire were checked for consistency and completeness by the supervisor. In selecting the study households, the "spin the bottle technique" was used to identify the starting point within the sample area (Espeut, 2001). The household that corresponds to the mouth of the bottle were assigned the starting point of the first household. The next household to be interviewed used "fifth closest rule" that is every fifth household interviewed till the required sample size of each cluster was attained. The researcher repeated the same procedure in the next clusters until 14 clusters were attained.

### Ethical considerations

The ethical approval of this study was granted by Maseno University, Institute of Public Health Ethical Review Committee and Kenya Medical Research Institute. A written informed consent was sought from each head of the households involved.

### Data analysis

After data collection, all the data were edited, coded, entered and analysed. Responses from all questions were crosschecked to facilitate coding and processing for analysis using Statistical Package for Social Sciences (SPSS version 18). Statistical analysis of data was done by descriptive statistics and parametric logistic regression analysis was used to explore the possible association between knowledge of malaria using IRS as a control tool and socio-economic factors. All data were analysed at a level of 95% or  $\alpha = 0.05$ .

## Results

### Socio-demographic characteristics

A total of 348 people were interviewed, one corresponding to each household, 41% (n = 143) were males and 59% (n = 205) were females. The age of the interviewees ranged from 18 to over 55 years. Forty-three percent (n = 151) of the interviewees were aged below 35 years. In terms of statistical comparison of the years; the differences in age distribution among the respondents were, significant ( $\chi^2 = 152.374$ , df = 4,  $P < 0.001$ ). The majority (99.7%) of the interviewed respondents were Christians. On marital status 77.3% (n = 269) of the respondents were married with few living single 17.5% (n = 61) and 5.2% were divorced and separated. These differences were statistically significant ( $\chi^2 = 528.4$ , df = 3,  $p = 0.001$ ).

Males 77.9% (n = 271) headed majority of the households which was statically higher than female-headed households ( $\chi^2 = 108.2$ , df = 1,  $p < 0.001$ ). In terms of occupation, 19.3% (n = 67) of the respondents were in formal employment, while 43% (n = 160) were farmers, 26.9% (n = 94) were businessmen/women and a few were casual labourers 1.7% (n = 6) and housewives 8.9% (n = 31). There were significant ( $\chi^2 = 181.052$ , df = 4,  $P < 0.001$ ) differences in the variations of monthly income among the respondents. More than 71.8% (n = 250) of the respondents earned below US\$ 50 per month while only 1.1% (n = 4) of the respondents earned above KShs 20,000, 19% (n = 66) of the respondents were earning between US\$ 50-196.

**Table 1: The factors associated with the knowledge of malaria using IRS**

Factor	Regression coefficient	Significance	Odds ratio	CI (95%)
Age	3.5666	0.001	12.5	6.9 - 43.3
Marital status	2.426	0.017	7.4	4.1 - 33.1
Occupation	2.702	0.039	5.7	3.9 - 27.7
Income	2.163	0.010	8.1	4.4 - 38.9

**Key:** CI= confidence interval

Majority of the households 90.8% (n = 316) had between 2 - 10 dependants while about 5.5% (n = 19) of the households had over 10 dependants. Only 3.7% (n = 13) of the households had one dependant. The final economic indicator of the respondents was the types of walling materials. More than 80.2% (n = 279) of the respondents were using wood as plausible walling materials while 11.8% (n = 41) were using mud. The rest of the respondents were either using plaster or brick 8.1% (n = 28). There was a significant difference ( $\chi^2 = 17.226$ , df = 3,  $P = 0.001$ ) in the educational backgrounds of the respondents. The majority (84.5%; n = 294) of the respondents had each attained primary or secondary levels. The remaining 13.2% (n = 46) of the respondents attained college, and university level of education. Fewer respondents had adult education 1.4% (n = 5).

Logistic regression analysis was used to explore the association between knowledge on malaria control using IRS and socio - economic factors (Table 1). The results showed that the significant predictor variables for knowledge on malaria using IRS as a control tool were age, educational level, occupation and income levels ( $P < 0.05$ ).

### Community knowledge on malaria transmission

When asked “have you ever heard about malaria?” 99.4% ( $n = 346$ ) of the respondents stated yes. In this regard, the local community respondents were asked whether they knew about how malaria is transmitted. Over 94.5% ( $n = 329$ ) of the respondents identified mosquitoes as the main vector of malaria, while the rest mentioned rain 1.7% ( $n = 6$ ), eating maize stalks 2.9% ( $n = 10$ ) and contact with malaria patients 0.3% ( $n = 1$ ) as a source of malaria infection. Moreover, 76.7% ( $n = 267$ ) of the local community said that mosquitoes breed on stagnant water followed by dirty areas 15.2% ( $n = 53$ ). Twenty-eight (8%) respondents did not know where mosquitoes breed.

About 59.8% ( $n = 208$ ) of the respondents received information from the health facilities, while 19.3% ( $n = 67$ ) from schools. Other sources of information included the media 9.2% ( $n = 32$ ) and public meetings (*barazas*) 7.5% ( $n = 26$ ). Friends and health workers accounted for less than 10% ( $n = 13$ ) as a source of malaria knowledge (Figure 1). The majority (63.8%;  $n = 222$ ) of the respondents reported fever as the primary indicator of malaria illness, while 20% ( $n = 74$ ) of the local community felt that the signs of malaria can either be chills, headache, vomiting or diarrhoea. However, more than 14% ( $n = 51$ ) believed that both fever, chills, headache, vomiting, and diarrhoea can be signs of clinical malaria.

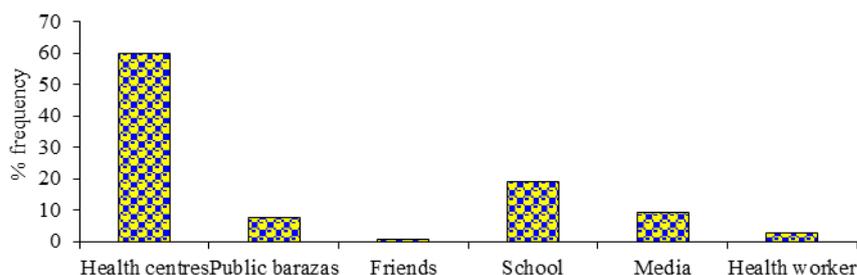


Figure 1: Community knowledge on sources of information about malaria transmission

### Community knowledge on methods of mosquito control

The local communities were asked whether they understood the main methods of mosquito control. Among the methods, cleaning of the surroundings 45% ( $n = 158$ ) and IRS 25.6% ( $n = 89$ ) were the most common responses. A few of the respondents mentioned draining and filling of ditches 11.8% ( $n = 4$ ), and smoking using cow dung 0.3% ( $n = 1$ ). The respondents were asked whether they know about IRS as one of the malaria control strategies in their area. Majority of the respondents 98% ( $n = 341$ ) knew about IRS. Neighbours formed the bulk of the sources of information about IRS to the local communities 45.1% ( $n = 157$ ). Other sources included the spray men 25% ( $n = 87$ ), health personnel 20.4% ( $n = 71$ ) and the mass media (6.9%) ( $n = 24$ ) (Figure 2).

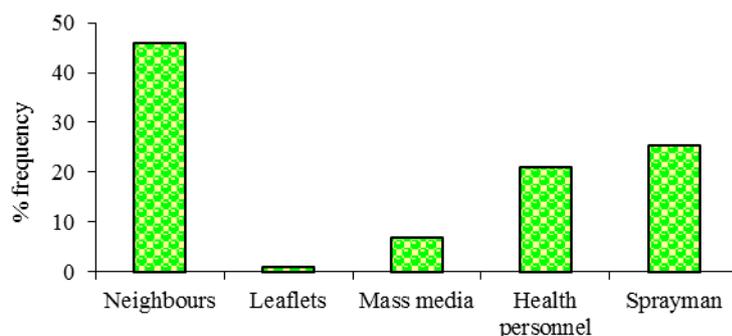


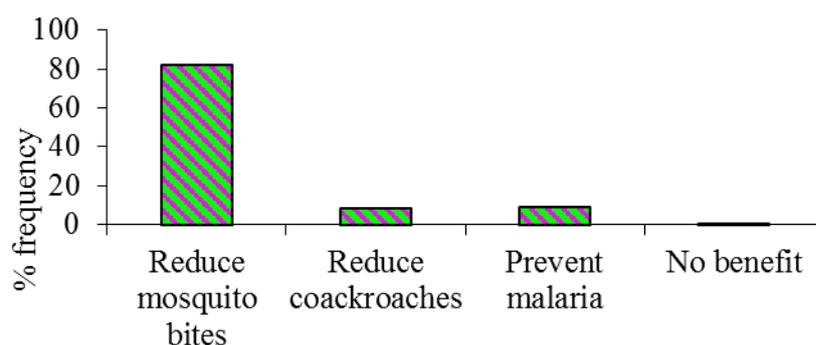
Figure 2: Community sources of information using indoor residual spray

### Community attitudes on frequency of malaria infection

A question was asked to determine how the local communities felt about the number of malaria episode during the last 3 years. Thirty one percent (n = 106) of the interviewees indicated having had no experience with malaria episodes, while 54% (n = 187) indicated that at least one member of their family had malaria during the previous year and the remaining 15% (n = 53) recalled bouts of malaria in the previous 2–3 years. Whether or not the local communities considered malaria as an important cause of mortality, 74% (n = 256) believed that malaria was an important cause of mortality, while 25% (n = 88) did not believe so. Only 1.1% of the respondents did not know whether malaria cause death or not. Those who believed that malaria is a fatal disease were further asked to explain the fatality of the disease. Only 282 (79%) answered the question; of which 49% (n = 172) attested that a family member had been admitted to the hospital suffering from malaria, while 19% (n = 67) had also witnessed death due to malaria to a member of the family while others had witnessed a villager who died of malaria 12% (n = 43).

### Community acceptability and benefits of IRS

Further we sought to know the community's perceptions on acceptability of the use of IRS as a malaria control tool. Of the 348 respondents, 97.1% (n = 333) attested that IRS is acceptable for use as a way of controlling malaria in their community. The remaining 2.9% (n = 10) did not believe that IRS could be effective to control malaria. Further responses on benefits of IRS were elicited among those who readily accepted IRS as a control tool for malaria transmission (Figure 3).



**Figure 3: Perceived benefits of using indoor residual spray**

When asked the reasons for spraying, 82% (n = 274) of the respondents associated it with reduction of mosquito bites inside houses, 9% (n = 29) said it helps to reduce number of cockroaches, 0.6% (n = 2) believed that IRS had no benefit at all. Only 9% (n = 29) associated IRS with prevention of malaria transmission. Among those who did not readily accept to use IRS they also had varied reasons for their choices (Table 3). Thirty percent (n = 7) of the respondents rejected IRS as an effective malaria control because of skin irritation, bad smell 35% (n = 8) and 21% (n = 5) because of poisoning of domestic animals. Others (13%) did not accept IRS because it stains wall or wastes time during usage (Table 3).

**Table 3: Reasons for not accepting the use of IRS N = 23**

Variable	Number	Percent
Poisoning of domestic animals	5	21.7
Stains walls	2	8.7
Skin irritation	7	30.4
Bad smell	8	34.8
Inconvenience/waste time	1	4.3
Total	23	100

### **Community practices on malaria control using IRS**

A total of 284 (83%) of the respondents had bought at least one product for protection against mosquito bite within the previous year. The most common product was a mosquito net 98% (n = 291). Mosquito repellent and insecticides had also been purchased by the local community but fewer less than 2% (n = 5). But only 80% (n = 235) of the respondents indicated that they use them all year round, 7% (n = 23) during the high mosquito abundance and 13% (n = 37) only during the wet season. When asked of the reasons for using self-protective measures including mosquito nets, 60% of the respondents indicated to use as protection against mosquito bite but only 40% (n = 116) related with prevention of malaria transmission.

Most of the respondents 47% (n = 158) had recently used IRS (less than six months before the study) while 35% (n=115) used IRS more than 6 months. About one-fifth (n = 66) of the respondents could not remember the last time they used IRS. Among those using more than six months, they cited the intervention being expensive as the main reasons, which have prompted them not to use it regularly 42.% (n = 56). Lack of community expertise 20% (n = 26) as well as lack of insecticide spray pumps 20% (n = 26) were also factors that limited the use of IRS interventions. Twenty-four (18%) respondents felt that lack of insecticides were the major reasons for not using the IRS strategy in controlling malaria. Time schedule for IRS spray team indicated that 80.5% (n =271) of the local community members attested to having sufficient time for IRS while the remaining 19% (n = 64) did not believe that the IRS spray team had sufficient time schedule for operations. Further result indicate that majority of the houses were often sprayed between the months of March to Septembers 48% (n = 137), followed by a period between January to December 37% (n = 105). Spraying activities were lowest (16%) during periods preceding August to November.

In terms of IRS co-ordination, most respondents (72%) said the activity was coordinated by public health officers from the Ministry of Health. Coordination by community spray men and community leaders accounted for 11% and 17% of the responses, respectively. Three quarters (73.4%) of the respondents usually checked actual spraying pump, while a half of the respondents each checked insecticide suspension, condition of the spray pump or nozzle discharge. According to the respondents, the challenges faced by IRS strategy included lack of chemicals (13.2%), lack of equipment (16.7%), lack of skilled personnel (24.6%) and lack of time 15%.

### **Discussion**

This study demonstrated that a good understanding about knowledge on malaria was documented, majority of the respondents were aware of what actually causes malaria. Similar findings have also been reported by other studies Uganda (Kilian *et al.*, 1999). In the contrary, a previous study by Munguti (1998) reported a relatively low proportion of household could associate malaria with mosquitoes. Therefore the relationship between mosquitoes and malaria transmission in the study community is highly important for the possession and utilization of IRS. It is anticipated that knowledge of this association predicts high IRS use. Although the association of malaria with mosquitoes is widespread in these communities, a study by Batega (2004) indicated that some community members have misconceptions about causes of malaria- and associated the disease with traditional beliefs like eating maize stalks, being rain on and contact with malaria patients.

In this study, three quarters of the respondents believed that the main breeding grounds for mosquitoes were stagnant waters. Previous studies have also confirmed similar findings (Klein *et al.*, 1995; Deressa *et al.*, 2004). Similarly, Knowledge of malaria can be further determined based on the occurrence of signs and symptoms of the disease. In this study, majority of the respondents attested that the main sign of malaria is fever, while few of the respondents felt that the signs of malaria can either be chills, headaches, vomiting and diarrhoea. Almost all of the participants in this study had knowledge about the main signs and symptoms

suggestive of malaria. Knowledge is usually high in areas with low to moderate transmission rates and where people are aware of the clinical manifestation of the disease (Deressa *et al.*, 2004). However, it might be low in areas of holoendemic transmission where the population has protective immunity against malaria (Ongore *et al.*, 1989).

In this study the local communities indicated that they used five main methods in controlling mosquitoes. Most respondents believed clearing of the environment (keeping the home and surroundings clean) and IRS as main vector control methods. In our study, the majority of the respondents knew about IRS as a control tool for malaria transmission. Their sources of information were quite varied; neighbours formed the bulk of the sources of information about IRS. This finding is inconsistent to previous studies indicating that radio to be the main source of malaria information (Okello-Ogojo, 2001; Batega, 2004; Mangeni, 2003). Overall, community attitude towards malaria as a disease is important in understanding their health seeking behaviour and use of preventive methods. In this study, majority of respondents believed that malaria was an important cause of morbidity in their households. Similarly, other studies in East Africa (Okello-Ogojo, 2001; Batega, 2004) have indicated that communities regard malaria as a dangerous disease that can kill. Such positive attitudes are essential opportunities for behaviour change campaigns.

The overall opinion in this study, among the respondents who did not readily accept to use IRS, they had varied reasons for their choice, ranging from skin irritation, bad smell, poisoning of domestic animals and stains the walls of their houses. These findings are in consistent with others elsewhere (Vundule & Mharakurwa, 1996; Rodríguez *et al.*, 2006). This study found that most of the respondents accepted IRS as a means for controlling malaria. Malaria control based on IRS has been described to heavily depend on this acceptability among the local community where there spraying is done (Konradsen *et al.*, 1999; Rodríguez *et al.*, 2006a). The acceptability of spraying is linked to whether householders perceive residual spraying as beneficial. In this study, only few of the interviewees regarded spraying as detrimental, and majority agreed with it, although no predisposition was found in the frequency they would like their houses sprayed. The findings that majority of the respondents believed that IRS was useful in reducing mosquito abundance with only few who believed that IRS was useful in preventing malaria are in the agreement with other studies (Rodríguez *et al.*, 2003, 2006). Further information was also sought as to which family members frequently used the self-protective measures. If not used by all members, mother was the single most important users of the self-protective measures accounting for over a quarter of the family members using the self-protective measures. Most fathers and sons were not enthusiastic about using the self-protective measures. Similar findings have been reported in Mexico (Rodríguez *et al.*, 2003).

In conclusion, the majority of the local community members had inherent knowledge about malaria, its symptoms, agent of transmission and several control methods. The best control method that the local advocated was the use of environmental control measures such as bush clearing. Many local community members generally welcomed the use of IRS as a new innovation in combating the spread of malaria.

### **Competing interests**

The authors declare that they have no competing interests.

### **Authors' contributions**

SM and ZK designed and conceived the study, coordinated recruitment of participants, collected and entered data, analysed data and drafted the manuscript. EJK, SM, ZK, FA and JV designed the study, participated in data analysis and reviewed the draft manuscript. NMT guided data analysis

and reviewed the draft manuscript. EJK, JV, FA and SM reviewed the draft manuscript. All authors read and approved the final manuscript.

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